

CONSERVATION INNOVATION GRANTS

Final Project Report

Grantee Name: Appalachian Sustainable Development

Project Title: Strip Tilling Vegetables to Boost Organic Matter, Farmland Conservation and Grower Productivity

Agreement Number: 69-33A7-13-009

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Period Covered by Report: January 2014 – March 2016

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Grant Agreement Deliverables

The following items were defined deliverables for this grant to be completed by ASD personnel and project collaborators:

1. The primary deliverable of this project will be the report compiling the results of two years of demonstration plots comparing strip tillage to plasticulture for wholesale vegetable production.
2. A PowerPoint presentation documenting the development and results of the demonstrations, will be developed and shared through Cooperative Extension across the Commonwealth to offer Virginia farmers another tool towards maintaining profitable and environmentally friendly farms.
3. Project Team members will be available to make presentations for agriculture groups (Virginia Beginning Farmer and Rancher Program, for example) and gatherings (such as the Appalachian Region Horticulture Conference, the VABF Conference and the Pumpkin Growers Association annual meeting) and as requested.
4. Southwest Virginia growers will benefit from public meetings and field days throughout the life of the project. We expect at least two public meetings and four field days for each year of the project. These field days will be advertised through ASD and Cooperative Extension channels, through the local media and through various agriculture organizations and interests across the Commonwealth. By selecting farms across the geographical span of southwest Virginia, a wide selection of interested farmers and agricultural professionals should have easy access to at least one of the field days organized through this project. Printed materials describing the scope and goals of this project will be prepared in advance of the field days to help educate participants and to share important contact information to folks who wish to follow up on what they have seen.
5. Other deliverables for NRCS include:
 - Performance items specific to the project that indicate progress.
 - Develop a new technology and innovative approach fact sheet.
 - Participation in at least one NRCS CIG Showcase or comparable NRCS event during the period of the grant.
9. Make recommendations to VA NRCS program managers on potential improvements to incentive programs as determined by the results of this project.

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Executive Summary

The purpose of this project was to experiment with strip-tillage in commercial vegetable production in order to build soil O.M. and hopefully reduce soil erosion.

Goal 1: Demonstrate through on-farm trials the efficacy of strip tillage for wholesale vegetable production.

Goal 2: Introduce southwest Virginia growers to the tools and strategies that best support strip till vegetable production through public meetings and farm tours.

Goal 3: Document the results of the various trials and create a report that shares the methodologies, labor needs, yields and lessons learned from the project to benefit all Virginia vegetable growers.

Accomplishments:

Multiple trials were conducted evaluating the effectiveness and practicality of utilizing strip tillage in broccoli, tomato and pumpkin / winter squash production. Equal, but delayed yield was obtained when comparing conventional and strip tillage in broccoli production. However, the heavy residue in the strip tillage treatment made planting very difficult, resulting in increased time and labor to set the crop. It actually took twice the time and labor to plant the strip tillage plot as compared to the conventional plot.

Again, heavy residue made extra work in the strip till tomato plot. For this trial, increased labor in setting the crop was observed. It also took extra time to apply the drip irrigation tape. This could be automated in the future, but that was not practical for the scope of this project. Also observed was increased disease in the lower fruit on the plants of the strip till plot. Strip till could have merit, but will produce lower yields than conventional plasticulture production.

Pumpkin and winter trials showed that strip tillage has a very natural fit in pumpkin and winter squash production. Yields were generally as good as that observed in conventional production. Also, due to the increased residue, the fruit was much cleaner from the strip till plot.

Goals and objectives of the project were met.

The project had to be extended for 6 months. Harvest of the pumpkins and winter squash did not occur until the fall (after the original project end date end in September 2015).

Pumpkin and winter squash producers are the direct beneficiaries of this project. Other vegetable producers and landowners are also beneficiaries of this work.

The project funds were spent as anticipated in the budget.

Field trials comparing strip tillage and conventional production methods were conducted. Yields were collected from each area. Other observations were made from each production

area of each crop. Soil samples were also taken from the different treatment areas. Quantitative data collected included, yield and soil O.M. Yields were equal between conventional and strip till broccoli. Tomato yields were lower from the strip till plots were lower than from plasticulture production areas. Yields were about the same between conventional and strip till plots of pumpkins and winter squash.

Adapting strip tillage in broccoli production would be marginally economically feasible. However, strip tillage did increase the O.M. content of the soil. Strip tillage in tomato would not be economically beneficial. Strip tillage in pumpkin and winter squash would be economically beneficial. Yields are very comparable and production costs should be lower from strip tillage. Fruit would also be cleaner resulting in less need for washing.

The Commonwealth of Virginia gives tax exemptions for purchasing conservation tillage equipment. Natural Resource Conservation Service may have some programs that might be able to assist some growers.

Adoption of strip tillage in broccoli production should be given thoughtful consideration before adoption. Adoption of strip tillage in tomatoes should only be considered if erosion control is not obtainable using conventional plasticulture production. Strip tillage should be considered as a standard production in pumpkin and winter squash production. Implementation should be encouraged.

Introduction

Appalachian Sustainable Development (ASD) is a not-for-profit organization working in the Appalachian region of Virginia and Tennessee. Formed in 1995, ASD focuses on developing healthy, diverse and ecologically sound economic opportunities through education, training, and the development of cooperative networks and marketing systems.

ASD is well connected to the farming population in southwest Virginia and northeast Tennessee through our work with Appalachian Harvest (a wholesale vegetable aggregation and distribution business), the Appalachian Farmers Market Association (AFMA - a network of 35 Farmers Markets throughout the region) and Rooted in Appalachia (a local food promotional campaign for area restaurants and small retailers). Through these three programs, ASD's work supports the efforts of hundreds of farmers each year through direct technical assistance, marketing support and educational/networking opportunities.

This project was a Conservation Innovation Grant (CIG) in the Commonwealth of Virginia, and was a joint project between ASD and VT Cooperative Extension. The overall objective was to demonstrate and document the benefits of strip tilling for wholesale vegetable production in southwest Virginia. This project met the priority need of Soil Health (as identified by NRCS) by promoting growing systems that:

- 1) Maintain cover on the soil surface, and
- 2) Reduce soil disturbance

The primary method for raising wholesale vegetables in southwest Virginia is a plasticulture

system. In this system, the entire field to be planted is plowed or tilled (often multiple times), raised beds are formed and linear rows of plastic mulch (generally 3 – 4' wide) are stretched tightly over these rows with 1 – 2 lines of drip tape laid beneath the plastic for season-long irrigation. Plasticulture allows for early season warming of the soil, reduced weed pressure on growing crops and reduced soil splash on produce, but it also greatly disturbs the soil profile, opens the soil (and the uncovered pathways between the plastic rows) to erosion and creates an annual supply of waste plastic.

Southwest Virginia is traditionally a Burley tobacco producer and, while most producers grew tobacco on bare ground, many have experimented with a strip tillage system that keeps the majority of the soil surface covered with organic debris from winter cover crops. In strip tillage, only a small band of soil where the crop is grown is disturbed while the rest remains covered with organic mulch. This undisturbed ground is far less prone to erosion and aids greatly in both the percolation and retention of soil moisture. Organic matter in the soil is preserved which both stores crop nutrients and sequesters carbon. In addition, Cooperative Extension experience shows that tobacco growers saved up to \$125.00 / acre in land preparation costs using the strip till system – about 2/3 of total land preparation costs in conventional systems while maintaining equal or better harvest yields.

This project tried to duplicate these results with vegetable production, noting savings in land preparation and comparative yield data for each plot.

Goal 1: Demonstrate through on-farm trials the efficacy of strip tillage for wholesale vegetable production.

Goal 2: Introduce southwest Virginia growers to the tools and strategies that best support strip till vegetable production through public meetings and farm tours.

Goal 3: Document the results of the various trials and create a report that shares the methodologies, labor needs, yields and lessons learned from the project to benefit all Virginia vegetable growers.

This project focused on four farmers – Ron DeHart in Floyd County, VA, Hayden Lyons in Tazewell County, VA, Greg Church in Washington County, TN, and Jones Farms* in Unicoi County, TN. Each farm committed land to the project – one section was strip tilled and the other was raised using the same crop in a conventional / plasticulture system. These farms were chosen to represent a wide variety of southwest Virginia climates and were all farmers with solid experience in the production of vegetable crops for wholesale markets.

**Frank Jones dropped out of the project in the second year due to religious beliefs. Eventually he decided to stop farming and his farm is now on the real estate market.*

The project was a cooperative effort between Appalachian Sustainable Development and Virginia Cooperative Extension, with oversight from NRCS. Chick Fish of ASD is a 20 + year veteran tomato grower. R. Allen Straw with Virginia Cooperative Extension has worked with vegetable production for over 30 years.

Funding was provided by NRCS through a Conservation Initiative Grant.

Background

The primary method for raising wholesale vegetables in southwest Virginia is a plasticulture system. In this system, the entire field to be planted is plowed or tilled (often multiple times), raised beds are formed and linear rows of plastic mulch (generally 3 – 4' wide) are stretched tightly over these rows with 1 – 2 lines of drip tape laid beneath the plastic for season-long irrigation. Plasticulture allows for early season warming of the soil, reduced weed pressure on growing crops and reduced soil splash on produce, but it also greatly disturbs the soil profile, opens the soil (and the uncovered pathways between the plastic rows) to erosion and creates an annual supply of waste plastic. Other crops are grown utilizing conventional tillage. Producers would benefit from healthier soils, including better soil biology and retention of top soil from reduced erosion. The public would benefit from cleaner surface water supplies from the reduction in soil erosion.

Review of Methods

Broccoli

Most producers in the Blue Ridge Plateau region of Virginia utilize conventional tillage for broccoli production. Plants are grown in double or triple row configuration, resulting in very high plant populations. Strip tillage in this production system could reduce soil erosion and increase soil health. The trial was conducted for 2 years with Ron DeHart in Floyd County. The strip tillage system actually produced comparable to conventional tillage. However, there was a slight delay in maturity with the strip tillage system. The biggest concern was the increase in planting time and labor. The heavy residue made it very difficult to plant the broccoli plants. Even utilizing a reduce tillage plant setter. Future work would be in management of residue to maximize soil health, while facilitating planting.

Tomatoes

Again, as with broccoli, residue management was a serious issue. Planting time was much longer with the strip tillage system as compared to the conventional system. Also, due to the need for more field walkers to ensure the plants were set properly and the installation of the drip line by hand, labor costs were greater with the strip till system. Yields were less and delayed as compared to the standard plasticulture production system. There were also more severe disease issues on the fruit in the strip tillage plots. Weed control was also more difficult. There is a potential for the strip tillage system having some merit on steep slopes. However, as a rule, strip tillage is actually digressing in tomato production.

Pumpkins and Winter Squash

Of the crops evaluated, pumpkins and winter squash production responded the best to the strip tillage system. Tillage expenses are reduced and cleaner fruit is harvested utilizing the strip tillage system. Yields were very comparable to the yields from conventional systems. We

believe strip tillage should be adopted by more pumpkin and winter squash producers.

Quality Assurance

The trials were large scale research / demonstration plots in actual growers' fields. Plots were at least ½ acre in size and were representative of the producer's practices. The strip tillage treatments were imposed into established cover in the growers' fields.

All of the strip tillage plots were established utilizing a Zone Builder from Unverferth Corporation. The plots were large enough to accommodate the equipment and provide reliable data. Soil samples were collected randomly from each area and sent to the soils lab at VA Tech or A & L Labs in Memphis, TN.

Findings

Broccoli

Most producers in the Blue Ridge Plateau region of Virginia utilize conventional tillage for broccoli production. Plants are grown in double or triple row configuration, resulting in very high plant populations. Strip tillage in this production system could reduce soil erosion and increase soil health. The trial was conducted for 2 years with Ron DeHart in Floyd County. The strip tillage system actually produced comparable to conventional tillage. However, there was a slight delay in maturity with the strip tillage system. The biggest concern was the increase in planting time and labor. The heavy residue made it very difficult to plant the broccoli plants. Even utilizing a reduce tillage plant setter. Future work would be in management of residue to maximize soil health, while facilitating planting. At present, the economic feasibility and added planting cost and labor would prohibit many producers from adopting this practice.

Tomatoes

Again, as with broccoli, residue management was a serious issue. Planting time was much longer with the strip tillage system as compared to the conventional system. Also, due to the need for more field walkers to ensure the plants were set properly and the installation of the drip line by hand, labor costs were greater with the strip till system. Yields were less and delayed as compared to the standard plasticulture production system. There were also more severe disease issues on the fruit in the strip tillage plots. Weed control was also more difficult. I can see the strip tillage system having merit on steep slopes. However, as a rule, strip tillage is actually digressing in tomato production. Economically, strip tillage of tomatoes is not feasible when compared to the conventional plasticulture system.

Pumpkins and Winter Squash

Of the crops evaluated, pumpkins and winter squash production responded the best to the strip tillage system. Tillage expenses are reduced and cleaner fruit is harvested utilizing the strip tillage system. Yields were very comparable to the yields from conventional systems. We believe strip tillage should be adopted by more pumpkin and winter squash producers. The use

of the strip tillage system is practical and economically beneficial.

Conclusions and Recommendations

Broccoli

Most producers in the Blue Ridge Plateau region of Virginia utilize conventional tillage for broccoli production. Plants are grown in double or triple row configuration, resulting in very high plant populations. Strip tillage in this production system could reduce soil erosion and increase soil health. The trial was conducted for 2 years with Ron DeHart in Floyd County. The strip tillage system actually produced comparable to conventional tillage. However, there was a slight delay in maturity with the strip tillage system. The biggest concern was the increase in planting time and labor. The heavy residue made it very difficult to plant the broccoli plants. Even utilizing a reduce tillage plant setter. Future work would be in management of residue to maximize soil health, while facilitating planting. At present, the economic feasibility and added planting cost and labor would prohibit many producers from adopting this practice. We would recommend producers evaluate the strip tillage in their system prior to widespread adoption.

Tomatoes

Again, as with broccoli, residue management was a serious issue. Planting time was much longer with the strip tillage system as compared to the conventional system. Also, due to the need for more field walkers to ensure the plants were set properly and the installation of the drip line by hand, labor costs were greater with the strip till system. Yields were less and delayed as compared to the standard plasticulture production system. There was also more severe disease issues on the fruit in the strip tillage plots. Weed control was also more difficult. We can see the strip tillage system having merit on steep slopes. However, as a rule, strip tillage is actually digressing in tomato production. Economically, strip tillage of tomatoes is not feasible when compared to the conventional plasticulture system. We would not recommend general adoption of strip tillage production in tomatoes. However, on fields with steep slopes, would encourage its use to prevent soil erosion.

Pumpkins and Winter Squash

Of the crops evaluated, pumpkins and winter squash production responded the best to the strip tillage system. Tillage expenses are reduced and cleaner fruit is harvested utilizing the strip tillage system. Yields were very comparable to the yields from conventional systems. We believe strip tillage should be adopted by more pumpkin and winter squash producers. The use of the strip tillage system is practical and economically beneficial. We would highly recommend adoption by most if not all pumpkin and winter squash producers.

Future Adoption of Strip Tillage in Vegetables

The next step in promoting the adoption of strip tillage in vegetable production is for growers to plan on utilizing the system and investing in the purchase of the equipment. Planning includes the establishment of a fall cover crop. This will generally include a small grain and

can include legumes like vetch or Austrian winter pea and would require management of that cover crop in the spring. This means controlling the growth with mechanical or chemical means and may even require the removal of some of the residue. The biggest issue is the purchase of the equipment. Some producers have found used equipment at auctions. However, many producers would actually have to purchase new strip tillage equipment. This usually means the investment of \$10,000 or more. For large producers this isn't an issue. However, for many small producers, this cost can be overwhelming.

Deliverable Outcomes

Following are details on the outcomes achieved through the implementation of this project.

1. Report compiling the results of two years of demonstration plots comparing strip tillage to plasticulture for wholesale vegetable production.
Outcome: see information above
2. A PowerPoint presentation documenting the development and results of the demonstrations, will be developed and shared through Cooperative Extension across the Commonwealth to offer Virginia farmers another tool towards maintaining profitable and environmentally friendly farms.

Outcome: Two PowerPoint presentations are attached.

- *Strip Tilling Vegetables NRCS CIG*: a presentation documenting the results of strip tilling used on vegetable production in southwest VA
 - *Photos Strip Tilling Vegetables NRCS CIG*: a compilation of photographs taken throughout the project
3. Project Team members will be available to make presentations for agriculture groups (Virginia Beginning Farmer and Rancher Program, for example) and gatherings (such as the Appalachian Region Horticulture Conference, the VABF Conference and the Pumpkin Growers Association annual meeting) and as requested.

Outcome: The project team made 4 presentations on methods and data in 2015, including presentations to the VA Pumpkin Growers Association, Appalachian Harvest growers, the Appalachian Regional Horticulture Association and a Joint Educational Development training session for NRCS.

- On January 31, 2015, methods and data were presented at the Virginia Pumpkin Growers Association Annual Meeting in Hillsville VA. There were 100+ people in attendance including several extension agents, seed and chemical representatives, and marketing agents. Virginia Tech Grad student, Shaun Francis, also presented his data from the Lyons Farm and VT Kentland Farm. (This is the Grad student who had earlier been removed from the project due to performance and health issues. He has since returned to the project.)
- On February 9, 2015, methods and data were presented at the Appalachian Harvest cucurbits workshop and training in Duffield, VA. There were 10 growers in attendance.
- On February 20, 2015, methods and data were presented at the Appalachian Regional Horticulture Conference in Abingdon, VA. There were 50+ people in attendance from several states, including 3 extension agents, several seed and chemical representatives, equipment dealers and marketing agents.
- On April 16, 2015, methods and data were presented at a Joint Educational Development session in Wytheville, VA with approximately 50 attendees.

4. Southwest Virginia growers will benefit from public meetings and field days throughout the life of the project. We expect at least two public meetings and four field days for each year of the project. These field days will be advertised through ASD and Cooperative Extension channels, through the local media and through various agriculture organizations and interests across the Commonwealth. By selecting farms across the geographical span of southwest Virginia, a wide selection of interested farmers and agricultural professionals should have easy access to at least one of the field days organized through this project. Printed materials describing the scope and goals of this project will be prepared in advance of the field days to help educate participants and to share important contact information to folks who wish to follow up on what they have seen.

Outcome: Two field days were held on September 13, 2014 and January 31, 2015 with the VA Pumpkin Growers Association. Growers attending one field day in Floyd County expressed concerns about the cost of the equipment required for strip tillage which represents a potential opportunity for NRCS or other partners to increase adoption through the availability of a rentable strip tiller.

9. Make recommendations to VA NRCS program managers on potential improvements to incentive programs as determined by the results of this project.

Outcome: Please see attached Recommendations document.